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14. ABSTRACT  Since the end of the Cold War, the US Navy has reduced its Anti-Submarine Warfare (ASW) force structure and training dollars. Today, US ASW forces, surface, air, and submerged, have been cut significantly and/or they have assumed other missions to maintain relevance in the changing naval and conflicts of the 1990s and early 21st century. As this draw down was occurring within the US Navy, much of the rest of the world was acquiring submarine technologies for the first time or modernizing and expanding their current submarine forces. The diesel submarine is seen by some countries as the ultimate "asymmetrical" weapon for employment against the US Navy. The current US Navy force structure is inadequate to meet the challenges posed by these potential threats. ASW is a core mission area for the US Navy. Right or wrong, a shift from ASW has occurred. The current status of ASW readiness, training, and forces in the Fleet must improve. It is vital the Navy meet and overcome these challenges which threaten the vision of Sea Power 21					
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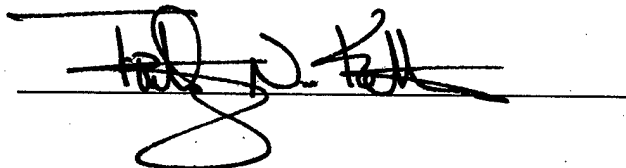
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Anti-Submarine Warfare in the 21<sup>st</sup> century

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of National Security Decision Making.

The contents of this paper reflect my own personal views, and are not necessarily endorsed by the Naval War College or the Department of the Navy.

A handwritten signature in black ink, appearing to read 'Timothy N. Ketter', is written over a horizontal line. The signature is stylized with a large loop at the end.

May 20, 2004

The military forces of the United States are at a crossroads. Much of the force was planned, funded, and fielded to provide security against the symmetrical threat presented by the Soviet Union during the latter half of the 20<sup>th</sup> Century. That enemy has withered away and currently the US is the world's only remaining military "Superpower." In the near term it is unlikely that the US could be defeated in a traditional force on force conflict. The costs of developing such a force are prohibitive and as a result potential adversaries are investing in a variety of asymmetrical capabilities to offset US conventional military strength; hoping to exploit vulnerabilities that have developed in the current US force structure over time. Potential gaps became evident as a result of the September 11<sup>th</sup> attacks, Operation Enduring Freedom, Operation Iraqi Freedom, and through analysis of US military spending trends. This paper will analyze the diesel submarine as an asymmetrical capability which threatens the US Navy's vision of Sea Power 21. Advanced diesel boats, if manned by capable crews, have the potential to disrupt Sea Strike missions, force the allocation of additional resources to Anti-submarine Warfare (ASW) to meet Sea Shield requirements, and put at risk the Sea Bases which must be developed to project power and support forces ashore. For these reasons it is vital the US Navy re-examine its current ASW doctrine, strategy and force structure and make investments now for a future force that can overcome the challenges presented by the diesel submarine. This operational refocusing must be completed preemptively rather than waiting for a calamitous event to shock the system and force change. Time and money are limited resources, and the attention span of the American public has never been shorter. The combination of these factors combined make it unlikely the Navy will have the capacity to quickly develop a credible, calculated ASW response in a political environment where attempts to assign blame override the reform necessary to meet the challenge.

## **Historical Background**

This is not the first time the Navy faced an adversary possessing a credible diesel boat force. During WWI and WWII, the US Navy developed a strategy and doctrine to combat the German U-Boat threat in the Atlantic Ocean. However, this occurred reactively after an enormous quantity of US and British merchant vessels were sunk by the U-Boats. Also, the ASW lessons of the First World War seem to have been forgotten in the inter-war years. The US Navy at that time was focused on building battleships and training for an epic Fleet on Fleet engagement that would never occur, at least not in the manner naval leaders envisioned at this time. Given that Germany did not have the industrial capacity to build a large number of battleships; it developed a naval strategy to innovatively use U-Boats as asymmetrical weapons against British and American merchant shipping and, given favorable conditions warships. In response the British and Americans developed sonar or "ASDIC" which hoped to remove from the submarine the cloak of invisibility which was its principal source of strength late in WW1.<sup>1</sup> However, the ASW training conducted by both the US and Royal Navy was deficient. Conducted under unrealistic environmental conditions, it lead naval officers to believe that U-Boats could be easily detected by radar when they went to periscope depth just prior to attack. Further, ASW training was limited to a small percentage of the officer corps of both countries' navies.<sup>2</sup> When the Battle of the Atlantic was finally won, it was due to a combination of factors: first, the development of ASW tactics which combined ASW aircraft operating from escort carriers and land bases with surface ASW forces; second, the convoying and escort of merchant vessels; three, improved ASW weapons; and last, the ability to decipher German naval messages

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<sup>1</sup> Ronald H. Spector, *At War at Sea: Sailors and Naval Combat in the Twentieth Century*, (New York: Penguin Putnam, 2001), 225.

<sup>2</sup> Ibid.

which enabled the Allies to redirect merchant convoys and ASW Task Groups hunting the German Wolfpacks.

Immediately following WWII, the threat of nuclear conflict with the Soviet Union began to dominate US Naval Strategy and would continue to so until the 1990s. The aircraft carrier combined with forward operating submarines would attack Soviet submarines in their home waters before they could threaten the United States or its allies.<sup>3</sup> In the 1950s, the Navy codified this into a three prong strategy to meet the Soviet challenge: strike submarine bases and shipyards in the USSR, intercept and destroy Soviet submarines as they sortied from their bases, and develop a strategic nuclear weapon delivery platform.<sup>4</sup> The last two depended upon the development of nuclear powered submarines which could operate submerged "indefinitely." The move to nuclear powered submarines caused the Navy's diesel submarine community to lose influence and ultimately become a part of naval history. It is during these years that naval submariners began to argue the best platform for tracking and killing submarines was another submarine, even though there was little empirical data supporting this statement. Surface and Air, carrier and land based, ASW forces were also modernized during these years. The large numbers of Soviet submarines made surface surveillance and coordination a secondary mission of every naval platform. US Naval commanders knew that the solution to the submarine threat did not lay in a single platform. Instead it required highly trained operators on ships, submarines, and aircraft integrated into a fused ASW network which maximized the efficiency and reach of every contributing platform. By the end of the 1980s, this solution finally came to fruition. At the conclusion of the Cold War, much of the US ASW force was allowed to atrophy

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<sup>3</sup> Ibid., 317.

<sup>4</sup> Ibid., 332.

due to a lack of funding for modernization programs, a reduction in ASW-centered training, and a shift in primary mission areas as warfare communities sought relevance in a post-Soviet world.

### **The Current Challenge**

The majority of conflicts of the late 20<sup>th</sup> and early 21<sup>st</sup> century have been fought against landlocked countries or ones which possessed few or no naval units. During these engagements the overwhelming focus of the Navy has been providing overland strike and support missions. Sea superiority had been taken as a “given” for all of these operations. Whether it was off the shores of Somalia or the Balkans, during Operation Enduring Freedom or Operation Iraqi Freedom, the Navy has been able to act with impunity. The most dangerous threat during this time has not been from other naval or land based units, but from free-floating mines or small boat suicide attacks, like the one experienced by the USS COLE in the port of Aden, Yemen. The diesel submarine may become the perfect asymmetric weapon for countries, which can afford to purchase them, and who wish to disrupt US power projection operations off their shores at some future date.

The collapse of the Soviet Union had the unintended consequence of allowing the proliferation of advanced submarine technologies to occur. Russia and other former Warsaw Pact countries have sold their most advanced technologies around the globe with little thought or care to the shifting balance of power these sales precipitate. Even traditional US allies have contributed to proliferation by selling weapons and sensor systems to the highest bidder. Diesel submarines are very flexible platforms. They may operate as or deploy mines, use stealth to attack an unsuspecting/unalerted target with torpedoes or submerged launched anti-ship cruise missiles (SLASCM), deliver Special Operation Forces (SOF), or conduct collecting intelligence, surveillance, and reconnaissance (ISR) missions. When operating on batteries or in congested

shipping lanes they are extremely difficult to detect. Battery improvements over time have resulted in shorter recharge times, greater efficiencies in maintaining a charge, and miniaturization has allowed a greater number to be installed on submarines. These improvements have significantly reduced a diesel submarine's exposure time during battery recharge operations, historically the time when they are most vulnerable to detection. Air Independent Propulsion systems currently under development by many countries threaten to make the diesel submarine nearly equal with nuclear submarines regarding submerged endurance.

US naval ASW doctrine, tactics, and weapons were developed to counteract a mirror image foe. Years of Cold War intelligence gathering missions against the USSR led to the development of extensive operational and acoustic databases from which determinations could be made regarding how the Soviets would use their submarines if conflict became unavoidable. Currently, US global information requirements do not always allow for the focused intelligence gathering required to determine the operating characteristics of potential adversary submarine forces. ASW has always been, and will continue to be dependent upon operational knowledge of the enemy and external cueing which leads to tactical interactions between opposing forces.

As previously mentioned, current and future diesel submarines possess an increasingly lethal array of weapon systems. Improved torpedo ranges and seekers, as well as automated fire control systems simplify and compress the attack timeline for the shooter and leave US commanders with shorter reaction times. These afford the submarine greater freedom of maneuver and decrease the chance of counter detection by US forces during weapons employment. Focused weapons development is also taking place by many countries. For example, wake homing torpedoes were specifically designed by the Soviet Navy to attack US

aircraft carriers. Conversely, US anti-submarine torpedoes were designed to attack large nuclear submarines in deep water, up to 1000 FT bottom depth. Diesel boats are significantly smaller and it is assessed they will operate in the littoral regions of the world. However during both World Wars, diesel submarines operated throughout the Atlantic and Pacific Oceans, therefore this assumption may be challenged in the coming years. The SLASCM may be the weapon system which pushes diesel boats forward once again.

The SLASCM possess a number of challenges for the US Navy, however, to be effectively used against an enemy the launching platform must possess over the horizon targeting (OTHT) data. Few countries currently have an operational OTHT network capable of employing these weapons at their maximum ranges. However, many countries are investing heavily in building the required infrastructure to make such a network a reality by the end of the decade. The network would connect land based, maritime, and air units through real time voice and data link circuits, allowing for the rapid transmission of information up, down and across the network. Once a reality, a SLASCM equipped diesel submarine could operate well outside traditional Carrier Strike Group (CSG) ASW search areas, receive cueing data via its OTHT network, launch a weapon submerged, and reposition totally undetected. Studies undertaken by the US Navy to demonstrate the survivability of the Trident SSGNs under construction indicate that even with an enemy submarine positioned within two nautical miles (4000 YDS) of a submerged missile launch event, no enemy firing solution could be achieved.<sup>5</sup> Some may argue that comparing a US Trident submarine to a Russian KILO or Chinese SONG is like comparing apples to oranges, and they would be correct. What the study indicates is that SLASCMs pose a significant challenge to US naval commanders. Solving the problem is more complex than just

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<sup>5</sup> Floyd D. Kennedy, "Transforming the Submarine Force: Integrating Undersea Platforms into the Joint Global [Strike Task Force]," *Air and Space Power Journal*, Fall 2002 [journal on-line]; available from <http://www.airpower.maxwell.af.mil/airchronicles/apj/apj02/fal02/kennedy.html>; Internet; accessed 4 May 2004.



building more submarines. For example, if the SLASCM has a nominal launch range of 20 NM, the "launch basket"<sup>6</sup> for such a weapon would be 1,256 NM<sup>2</sup> for a 60 NM range weapon the basket expands to 11,304 NM<sup>2</sup>. The waterspace which must be searched for these potential threats is immense. If the aforementioned study's 2 NM baseline is tripled, to account for the US's technological edge in sensor technology, the resultant submarine datum<sup>7</sup> is 113 NM<sup>2</sup>, which translates to 1% of the 60 NM weapons launch basket and the probability of having a US and adversary submarine in that same 1% of water at launch time is very low. As mentioned previously, the OTHT network required to employ these weapons at extended ranges are not yet fully mature but their capabilities are rapidly increasing. The United States Pacific Command (USPACOM) Area of Responsibility (AOR) will be used to demonstrate the growing diesel submarine challenge facing US commanders.

During Admiral Thomas B. Fargo's recent Congressional testimony before the House Armed Services Committee he stated "USPACOM faces the greatest undersea warfare challenge in the world." There are currently 250 submarines based in the Pacific and only 75 of these belong to the US or allied countries.<sup>8</sup> The majority of the remaining submarines are split between China and North Korea. All of North Korea's submarines are diesel electric boats used primarily to insert SOF personnel. They have rudimentary ASUW and ASW weapons. China, on the other hand, has a robust indigenous submarine production and maintenance base. They are currently constructing two classes of diesel submarines, identified as MING and SONG, as well as nuclear powered submarines for attack and ballistic missile missions. Lastly, the Chinese

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<sup>6</sup> The launch basket is a circle centered upon the naval unit the adversary wishes to attack. The demonstration values were chosen for demonstration purposes only.

<sup>7</sup> A datum "is the last know position of a submarine or suspected submarine after contact has been lost." *DOD Dictionary of Military Terms*, available from <http://www.dtic.mil/doctrine/jel/doddic>; Internet; accessed 4 May 2004.

<sup>8</sup> U.S. Congress, House Armed Services Committee, *Statement of Admiral Thomas B. Fargo, U.S. Navy Commander U.S. Pacific Command on the US Pacific Command Posture*, 31 March 2004, p. 16.

purchased a number of KILO submarines in the 1990s and have orders with Russian firms for a number of additional KILOs which will be delivered during the remainder this decade. The SONGs, Type 093 nuclear attack submarine, and new KILOs should be capable of launching SLASCMs. They will also be carrying some of the most advanced ASUW torpedoes in the world. The new construction MING and SONG submarines are replacing old noisy classes of boats. This modernization program is likely to continue in the second decade of the 21<sup>st</sup> century if not indefinitely.

Currently, US ASW forces are shrinking in numbers and a revitalization of ASW doctrine must take place. The attack submarine force level is set at 55 submarines. Maritime Patrol and Reconnaissance aircraft (MPRA) are reaching the end of their service lives and there will be approximately 150 active P-3s until the Multi-mission Maritime Aircraft (MMA) is fielded at the end of this decade. The S-3B, the only ASW capable carrier based aircraft has begun retirement and with the last squadron decommissioning in 2009. Surface combatants have been reduced in numbers and capabilities. For example, the new Flight II Arleigh Burke destroyers are no longer equipped with a passive towed array sonar system due to cost and space constraints that developed when the original hull was modified to incorporate a dual helicopter bay, required to deploy with ASW capable helicopters. ASW doctrine must be updated to address the ASW resource constraints and the emergence of the SLASCM equipped diesel submarine threat.

### **Submarine ASW**

The current US submarine force is divided almost equally between the Pacific and Atlantic Fleets. Many in the US Navy believe that the submarine will remain the premier ASW asset for the future.<sup>9</sup> Undoubtedly, US submarines now carry and will continue to deploy with the most capable ASW weapons in the Fleet; however they alone are not the solution to the

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<sup>9</sup> Ibid.

diesel submarine challenge. Submarines are the ideal ASW attack platform, but their slow search rates do not make them the optimum search platform unless cueing is available to focus their search. Also, the sheer number of potential adversary submarines demonstrates the need for greater numbers of improved ASW platforms to manage and reduce the risk to naval operations. A recent Congressional Budget Office study concluded that attack submarines spend only about 10 percent of their service life carrying out required missions; a very low return on investment.<sup>10</sup> Since funding and the industrial capacity is lacking to build additional submarines, the Navy needs to maximize the number of mission days available for each submarine during a given year. By permanently forward deploying submarines to Guam and Europe in greater numbers, the mission days available increases due to reduced transit times. For example, a single Guam based submarine is the equivalent of three continental United State (CONUS) based boats when comparing mission days available.<sup>11</sup> It will also go a long way to meeting the CJCS mission day requirements in the 2015-2025 time frames for attack submarines.

The disposition of the Fleet must also change to meet the evolving strategic environment in the Pacific AOR. By 2015, the 1999 CJCS study on attack submarine requirements concluded 60 percent of the fleet would be needed in the Pacific "to counter the threat in the Asia Pacific region."<sup>12</sup> Submarines should be re-allocated to Pacific squadrons along a phased timeline which begins immediately to offset the economic impact on communities which now host these boats. Once in the AOR, they would be ready to meet challenges as they arise. Additionally, the most capable submarines should enter service in the Fleet as members of Pacific squadrons. These boats will require less maintenance at the beginning of their service lives, further increasing the

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<sup>10</sup> U. S. Congress, Congressional Budget Office, *A CBO Study: Increasing the Mission Capability of the Attack Submarine Force*, March 2002, ix.

<sup>11</sup> *Ibid.*, xii.

<sup>12</sup> Rear Admiral Albert H. Konetzni, "How Many Subs Do We Need?" *Proceedings*, U.S. Naval Institute (November 2000), 57.

number of mission days available to the operational commander increasing his flexibility and reach.

Future innovation involving unmanned underwater vehicles (UUV), autonomous or tethered, operating from a host attack submarine or surface ship may radically increase ASW search rates. If the UUVs potential is to be fully realized the information gathered must be tactically relevant and transferred in real-time for interpretation by highly trained individuals on those vessels. Furthermore, ASW weapon capabilities must evolve to take advantage of the increased detection ranges offered by the UUV. This will give the operational commander a wider range of options as his units move into the joint operations area. (JOA)

### Air ASW

Land-based Maritime Patrol and Reconnaissance aircraft (MPRA) and unmanned aerial vehicles (UAV) can search large areas at higher speeds with reduced revisit times when compared to submarine search rates.<sup>13</sup> Currently, the Navy's air ASW force is modernizing current airframes and waiting for approval, funding and fielding of new airframes as old aircraft become unsustainable. The procurement of more capable fixed wing ASW assets is critical to operational success against diesel submarines. The P-3C is nearing the end of its service life and at the same time, the Navy has chosen to retire the S-3B Viking. Operating from the Aircraft carrier, the Viking's long endurance and APS-137 Inverse Synthetic Aperture Radar (ISAR) operating in periscope mode make it a valuable search and hold down platform against diesel submarines. Operating with similarly configured P-3C's enabled operational commanders to sanitize a large amount of ocean prior to CSG arrival, maintain search integrity and investigate only those contacts that meet periscope criteria. In the future, commanders will be completely dependent upon land-based maritime aircraft for ASW support. To increase asset availability

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<sup>13</sup> Revisit time is the elapsed time between sensor passes over a specific area.

and improve responsiveness in the PACOM AOR, consideration must be given to permanently forward deploying a P-3C squadron to Japan. CONUS based squadrons would maintain their normal deployment schedules to PACOM augmenting the forward deployed squadron and doubling the total number of aircraft in theater.

The future of this community is dependent upon the MMA and Broad Area Maritime Surveillance (BAMS) vehicle. The MMA will have increased range/on station time, more diverse sensor packages, and incorporate the latest acoustic and non-acoustic ASW technologies. The BAMS should incorporate radar and infrared sensor packages capable of searching large ocean areas, detecting periscopes, snorkels, and cruise missile launches at a minimum. Both the MMA and BAMS will be fully networked platforms whose information will be available across the joint fires network in real time. MMA and BAMS need to be acquired in sufficient numbers to meet the current and expected global combatant Commander requirements through 2025. Employed simultaneously, they will provide a persistent, overlapping ASW coverage umbrella which forces the diesel submarine commander to modify his scheme of maneuver.

The last piece of the air ASW triad is the MH-60R/S. These new SeaHawk helicopters will be responsible for maintaining air coverage in close proximity to the HVU or Sea Base. They will be the defensive rapid reaction force the Sea Combat Commander (SCC) has at his disposal to engage submarines. They are the only remaining organic CSG air ASW platform and it is critical that the program remain on timeline and fully funded. If not there is a risk that future CSGs will lack the defensive air ASW coverage necessary to adequately protect itself. Improved radar and acoustic systems on both helicopters should increase detection ranges and shorten prosecution timelines, enabling the SCC to prosecute a higher number of targets simultaneously.

## **Surface Community**

Surface combatants and their embarked ASW capable helicopters will provide defensive ASW coverage for the HVU. The surface ASW community is recovering after many years of neglect. New destroyers have the ability to permanently embark helicopter detachments increasing their ASW reach and mitigating somewhat the loss of their passive towed array sonar system. The Littoral Combat Ship (LCS), although not finalized, is being designed with an ASW module, including the ability to launch and recover UUVs. CG(X) and DD(X) will also incorporate improved acoustic ASW sensor suites and automatic periscope detection systems as they enter the Fleet in the next decade. These ships and ASW upgrades and retrofits must be funded in numbers sufficient to meet the expanding threat.

An area still under investigation by the surface community is the use of active sonar as a search sensor when water conditions are conducive. High ambient noise in the littoral regions of the world can limit the capability of passive sonar sensors. Using active sonar may increase detection ranges over what is available passively due to the water environment. Advances in acoustic planning tools allow the SCC to optimally place all available ASW units in the water column, maximizing the efficiency of those sensors, increasing detection opportunities, and reducing the probability of counter-detection. The use of SURTASS ships in passive and active roles is increasing. All of the ships have been moved to the PACOM AOR. The challenge with SURTASS is integrating the information they provide into the current operational network. The goal is to enable tactical decision making based upon SURTASS generated contact reporting.

## **ASW Doctrine**

ASW has not received the focus it deserved in the last decade. ASW is a slow, time consuming, asset intensive warfare area. The training required to maintain proficiency is lengthy

and perishable. To the untrained observer, ASW can be extremely boring. However, the most likely threat to the vision of Sea Power 21 is the diesel submarine. To meet this challenge the Navy must change the way it views and conducts ASW. The organizational model for the conduct of ASW at the theater level is outdated and ineffective. The historical areas of responsibility for a CSG Commander are too large for effective management. The number of combatants deploying in a Strike group has been reduced significantly, which limits the Commanders flexibility. Timesharing of combatants between the SCC and the Air Warfare Commander (AWC) is increasing, and at times there are not enough combatants to meet all the CSG's requirements.

Today, theater ASW organizations exist but they do not have the resources or doctrine required to manage a complex multi-contact ASW problem. Standing Task Force Commanders for ASW exist in 5<sup>th</sup>, 6<sup>th</sup>, and 7<sup>th</sup> Fleet AORs; however, they are not focused on managing tactical interactions. Doing so would allow for the resumption of direction, control, and coordination of ASW units outside of the CSG's area of influence. Close coordination between the SCC and the Theater ASW Commander (TASWC) will be critical for successful contact prosecution and asset protection. In this new alignment, the SCC would be responsible for defensive ASW within a bubble centered on the HVU; everything outside this bubble would be the TASWC responsibility. ForceNet will enable this shift of ASW responsibility and control to the theater level commander.

### **Conclusion**

In the future, US adversaries will attempt to disrupt naval operations through the use of asymmetrical weapons. The diesel submarine is simultaneously the most dangerous and most likely weapon to be used in that role. Its stealth and flexibility in the littoral regions of the world

give the opposing commander a variety of employment options against joint forces flowing in by sea. It is crucial the Navy rediscover its ASW ancestry and prepare now to meet and overcome challenges to US Sea Superiority created by diesel submarines. Many would argue that "our quiet submarines with superior sensors are the best resource to counter the threat posed by the growing number of quiet diesel submarines being employed by regional powers."<sup>14</sup> Simple math indicates that the US Navy will not have the number of submarines required to meet the challenge alone. Success, instead, requires a return to diesel ASW basics, increased intelligence gathering on potential hostile submarine forces, ASW force structure realignment and modernization, the construction of a fused ASW network which maximizes the efficiency and reach of every contributing platform whether they be air, surface, or submerged, the incorporation of UAV/UUVs into ASW, and doctrinal changes to effectively organize and manage ASW assets from the theater to the tactical levels of war. Change is never quick or easy, especially when those choices are complex, involving people and billions of dollars, but decisions must be made. Lastly, they must be based upon what is best for the security of the United States, not what is best for a specific warfare community, Fleet commander, congressional district, or even the United States Navy.

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<sup>14</sup> Chief of Naval Operations-Submarine Warfare Division Homepage, *Submarine Themes: Denied Areas*, <http://www.chinfo.navy.mil/navpalib/cno/n87/thems/denies.html>; Internet; accessed 4 May 2004.